



IB MYP YEAR 5

YEAR 10 Extended
Mathematics

Assessment #2
TRANSFORMATION OF FUNCTIONS

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Teacher: **Ms. Li, Mr. So & Mr. Wong**

Date of task: **Friday, November 2, 2012**

Time allowed: **60 minutes**

Student's Performance in Different Criterion			
B	4	C	3

INSTRUCTIONS:

- ◆ Read the instructions for all questions carefully.
- ◆ Show all work, steps and proper units.
- ◆ Ask the teacher for scrap paper, but any work on the scrap paper will **NOT** be marked.
- ◆ Write in **PENCIL**.
- ◆ **GDC** is allowed.
- ◆ Allowed to use **non-electronic dictionary**.

ASSESSMENT:

- ◆ Read the criteria descriptors carefully before you start your work. This will give you a clear understanding of what is required and what a quality piece of work for this task must include. This way you give yourself the best chance of achieving the highest level in this task.
- ◆ This task assesses Criteria **B & C** considering ALL the questions.
 - ✧ Criterion **C** will be assessed as an **overall impression** on the presentation of work in this assessment.

Criterion B: INVESTIGATING PATTERNS

Achievement level	Task Specific Rubric	IBO Published Descriptor	Student's self-evaluation
0	The student does not reach a standard described by any of the descriptors given below.	The student does not reach a standard described by any of the descriptors given below.	(0-8)
1-2 Do Maths	The student is able to <ul style="list-style-type: none"> Find some of the equations of the curves in part A. Recognize and describe some of the transformations in part A. 	The student applies, with some guidance , mathematical problem-solving techniques to recognize simple patterns.	
3-4 General Rule	The student is able to <ul style="list-style-type: none"> Do most of the questions in Part A and some questions in Part B. Apply knowledge to unfamiliar situations in Q10 and Q11. 	The student <ul style="list-style-type: none"> selects and applies mathematical problem-solving techniques to recognize patterns, and suggests relationships or general rules. 	Teacher's Final Grade
5-6 Test it	The student is able to <ul style="list-style-type: none"> Fulfill the requirements above. Deduce a general form for Q12. Apply and justify the general form in Q13. Find another transformation that works in Q14. 	The student <ul style="list-style-type: none"> selects and applies mathematical problem-solving techniques to recognize patterns, describes them as relationships or general rules, and draws conclusions consistent with findings. 	
7-8 Prove it	The student is able to <ul style="list-style-type: none"> Fulfill the requirements above Prove mathematically the answer in Q15. Identify the unfamiliar transformation in Q16 and find its equation in Q17. 	The student <ul style="list-style-type: none"> selects and applies mathematical problem-solving techniques to recognize patterns, describes them as relationships or general rules, draws conclusions consistent with findings, and provides justifications or proofs. 	

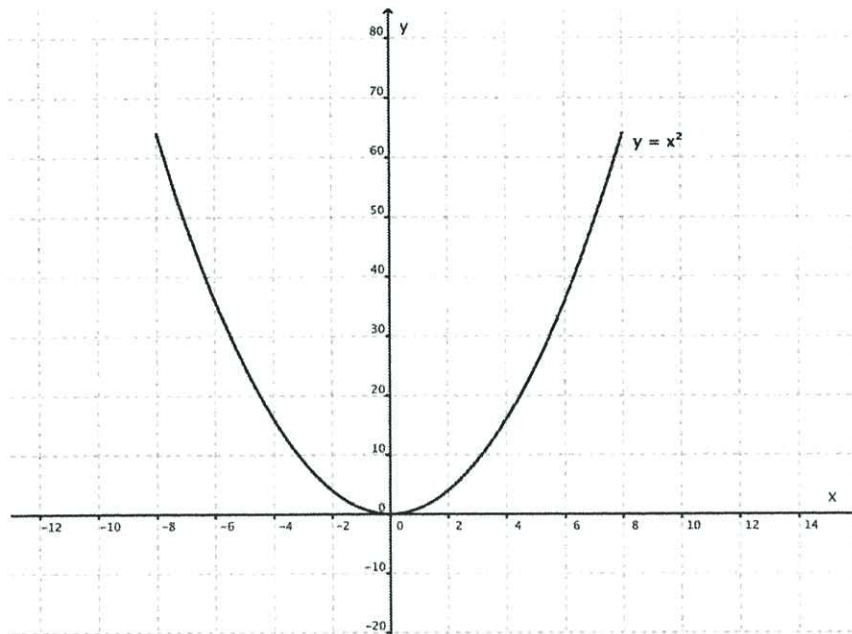
Criterion C: COMMUNICATION IN MATHEMATICS

Achievement level	Task Specific Rubric	IBO Published Descriptor	Student's self-evaluation
0	The student does not reach a standard described by any of the descriptors given below.	The student does not reach a standard described by any of the descriptors given below.	
1-2	There are some errors or inconsistencies in use of terminology . There are some errors in the writing of equations . Narrative is difficult to follow .	<ul style="list-style-type: none"> The student shows basic use of mathematical language and/or forms of mathematical representation. The lines of reasoning are difficult to follow. 	
3-4	Generally students use correct terminology accurately, with only a few errors . Equations are mostly written clearly and accurately. Narrative can be followed , and diagrams are clear and labeled.	<ul style="list-style-type: none"> The student shows sufficient use of mathematical language and forms of mathematical representation. The lines of reasoning are clear though not always logical or complete. The student moves between different forms of representation with some success. 	Teacher's Final Grade
5-6	The student uses the correct terminology accurately for most of the problems . Equations are clear and accurate Narratives are concise, logical and complete . All diagrams are clear and labeled	<ul style="list-style-type: none"> The student shows good use of mathematical language and forms of mathematical representation. The lines of reasoning are concise, logical and complete. The student moves effectively between different forms of representation. 	(0-6)

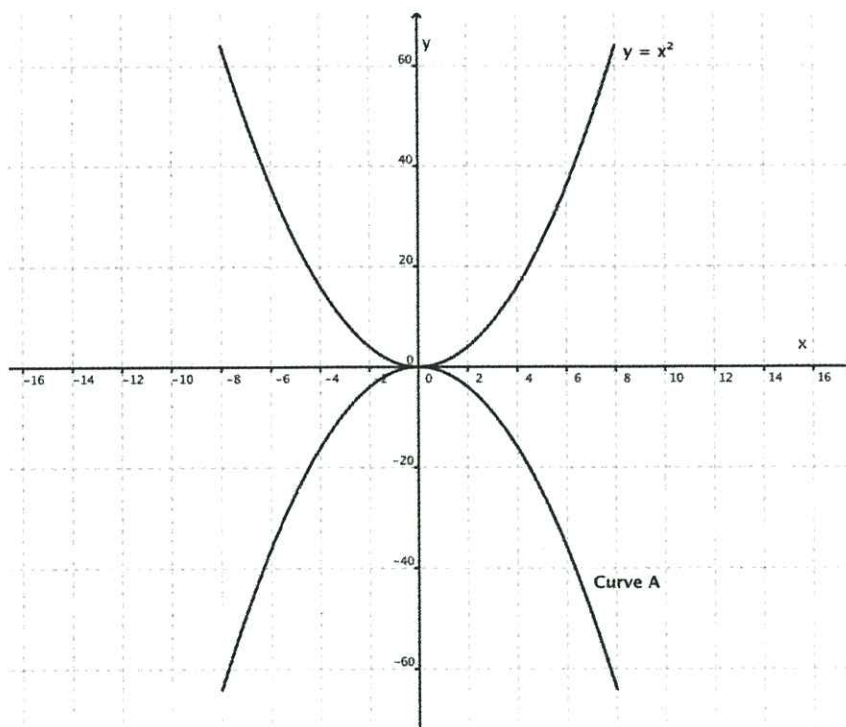
PART A (Suggested time: 20 minutes)

When the designers of the Hong Kong MTR were creating the now-famous logo, they decided to use transformations of functions.

They started with a parabola as in the graph below:



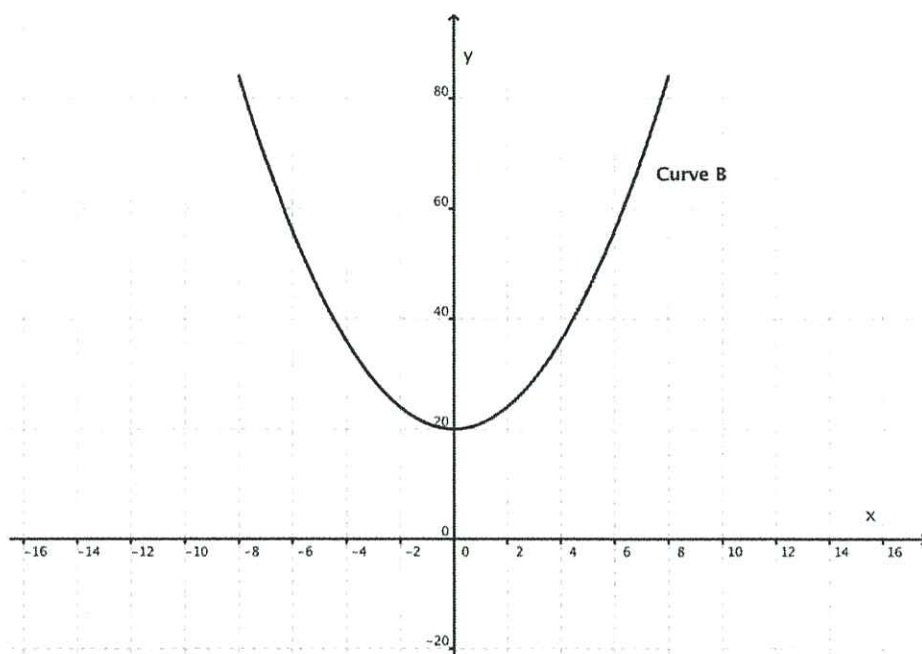
They then reflected this curve by the x-axis:



1. If the **starting curve** has the equation $y = x^2$, what is the **equation of curve A**?

$y = -x^2$

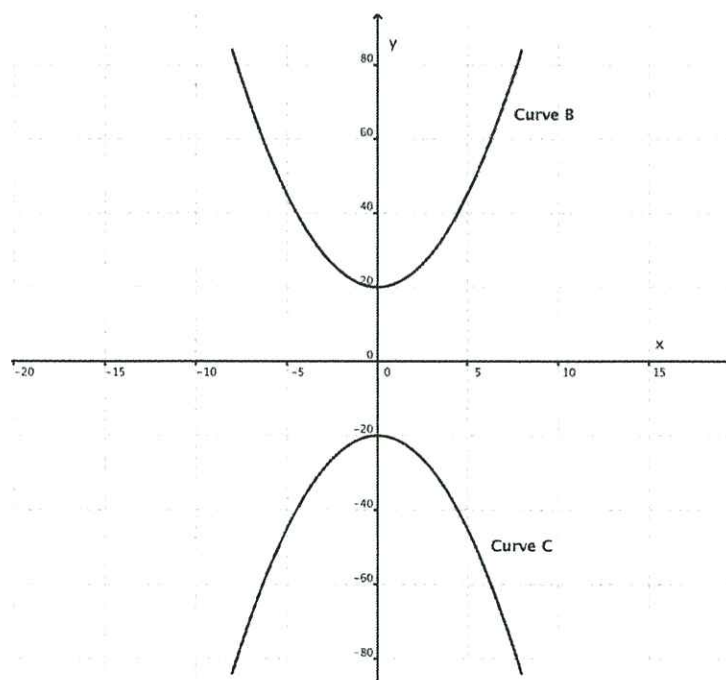
The designers then performed a transformation from their **starting curve**. It became this:



2. What do you think the **equation of curve B** is?

$$y = x^2 + 20$$

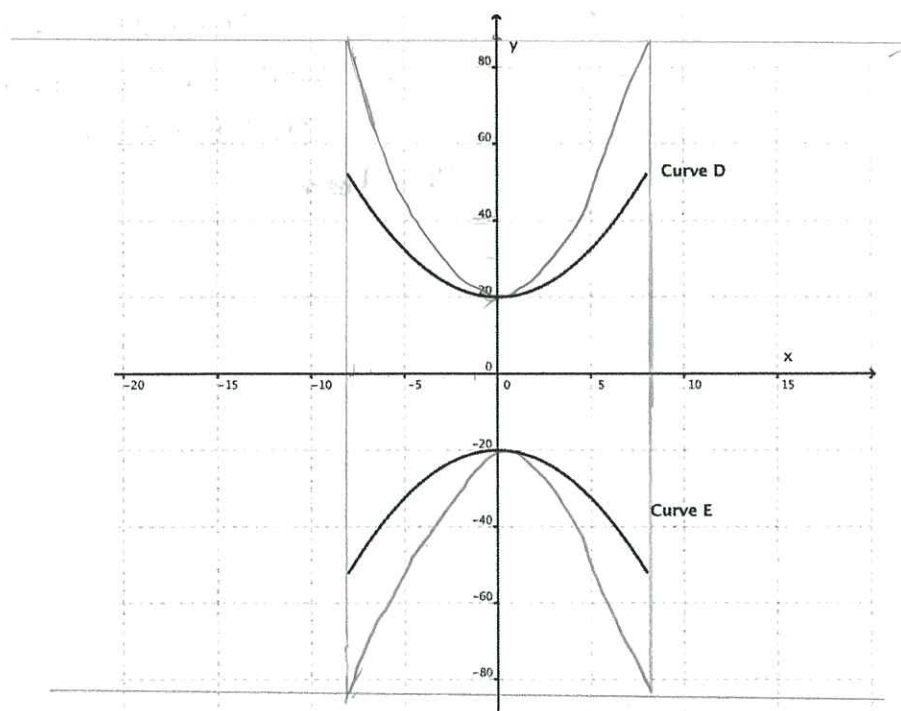
After the designers **reflected curve B** by the **x-axis**, they got **curve C**:



3. What do you think the **equation of curve C** is?

$$y = -(x^2 + 20)$$

The designers then went on to make one further alteration. The diagram below shows the results of that alteration. (Curves D and E are sketched on the same axes as B and C were on the last graph):



4. Describe in words what this last alteration was (to make **curve B become curve D** and **C become E**)?

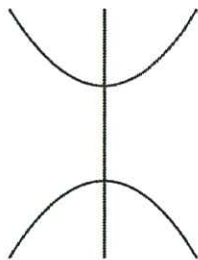
The curve D has change from curve B by enlarge 2 times along the x-axis
 The curve E has change from curve C by enlarge 2 times along the x-axis

5. What do you think the **equation of curve D** is?

$$y = \left(\frac{1}{2}x\right)^2 + 20$$

6. What do you think the **equation of curve E** is?

$$y = -\left[\left(\frac{1}{2}x\right) + 20\right]$$

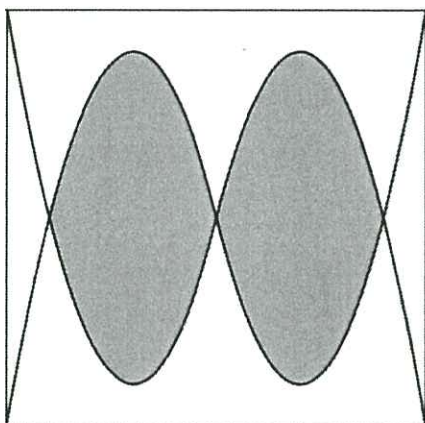


7. The "finished" logo is on the left. Describe fully the symmetry of the design

The logo can be Symmetry through the y-axis and also the x-axis, so the symmetry point in this picture will be at the center of the graph or the logo.

PART B (Suggested time: 40 minutes)

Here is a logo of a well-known sportswear company:

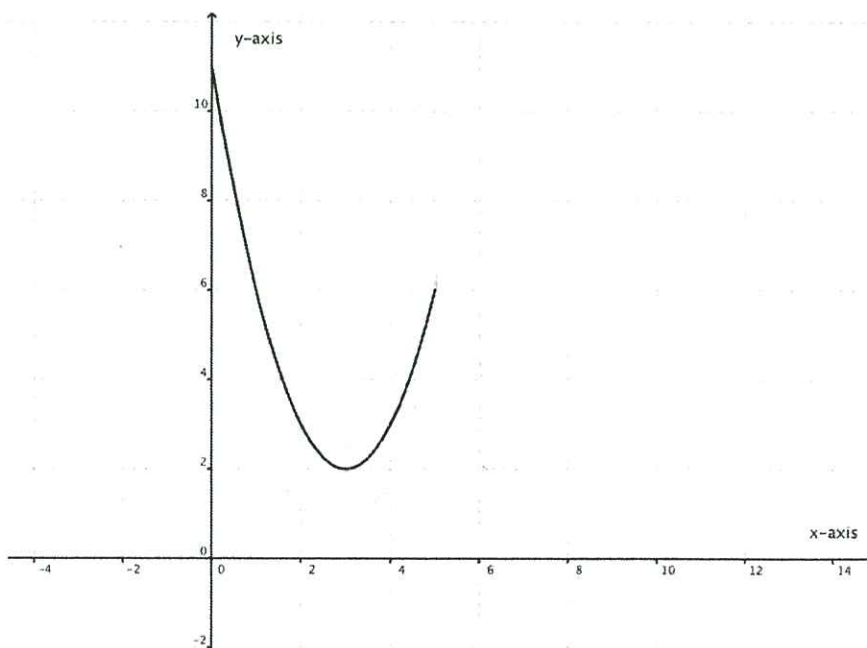


Two students, Ahmed and Delinda, are interested in the mathematics of the curves that make up the logo, and the relationship between the curves.

Ahmed believes that the design is really based on a simple curve (a quadratic), which is then transformed using simple transformations.

He says that the "basic unit" of the design below is

$$y = x^2 - 6x + 11 \quad 0 \leq x \leq 5$$



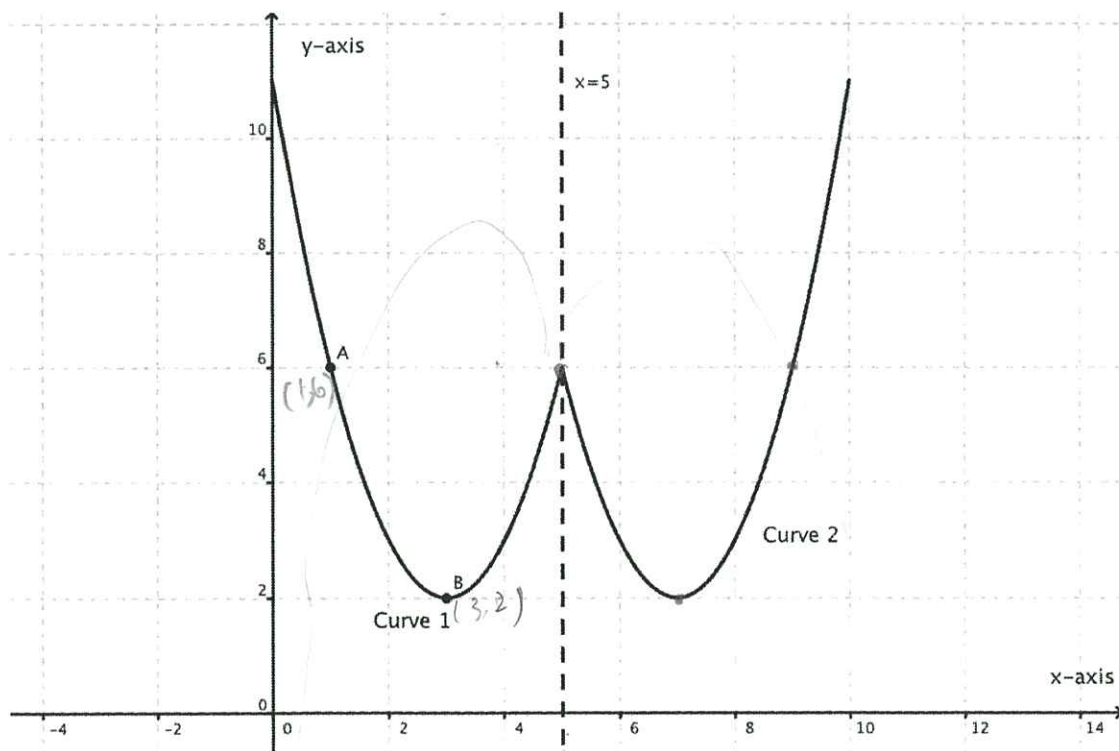
8. Show that the equation $y = x^2 - 6x + 11$ can be written as the **second form** $y = (x - 3)^2 + 2$.

$$\begin{aligned}
 y &= x^2 - 6x + 11 \\
 &= (x^2 - 6x + 9) + 2 \\
 &= (x^2 - 6x + 9) + 2 \\
 &= (x^2 - 6x + 3^2 = 9 - 3^2) + 2 \\
 &= (x - 3)^2 + 2
 \end{aligned}$$

9. Describe how this second form of the equation matches up with key features of the graph?

The key feature that we need to find out for the graphy is the steps that the curve move, and forming the second graph you easily to see that in the graph the steps that the graphy will make, like 3 to the left and 2 units upwards so it's more clear when people are drawing. It match up with the vertex of the curve which is $(3, 2)$.

He goes on to say that this curve is **reflected in the line $x = 5$** as shown below:



10. A is the point $(1, 6)$. What are the coordinates of the image of A after reflection in $x = 5$?

$$(9, 6)$$

11. B is the point (3, 2). What are the coordinates of the image of B after reflection in $x = 5$?

(7, 2)

12. P is the general point (x, y). What are the coordinates of the image of P after reflection in $x = 5$?

(5, 6)

13. Ahmed takes the x-coordinate of his answer to Q12, and substitutes this in for x in the original equation $y = x^2 - 6x + 11$. He (correctly) believes that it gives him the equation of curve 2. What equation for curve 2 does Ahmed get, and what range of values of x does it apply to?

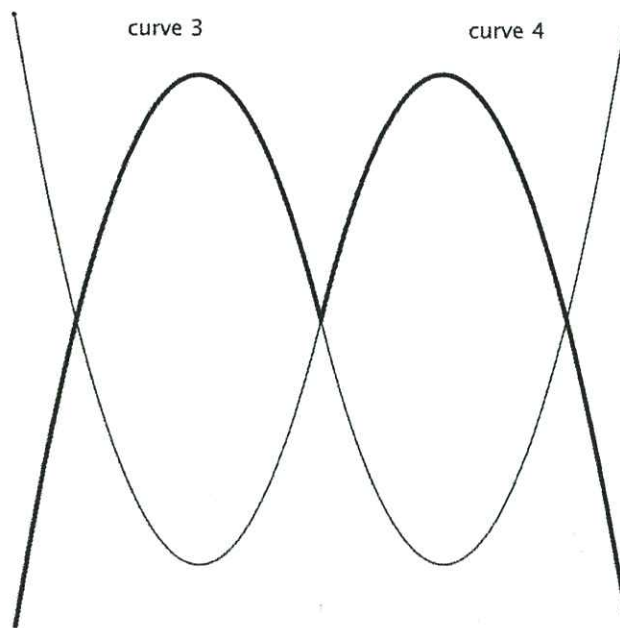
$y = 5^2 - 6(5) + 11 = 6$ $y = (x-6)^2 + 2$ The range of x is $0 < x < 5$

Delinda believes that Curve 1 in the diagram above can be transformed into Curve 2 **by a different way**.

14. What transformation(s) is/are Delinda thinking of? Give as many details as possible.

Delinda can also think of reflect along the y-axis to the other side or continue to reflect along the y-axis you will repeatedly get the curve 1 or curve 2, L and J and C etc.

15. Is it possible for both Ahmed and Delinda to be right? Explain your answer.



To complete the above logo, curve 1 is transformed into curve 3, and curve 2 is transformed into curve 4

16. What single transformation is performed on curves 1 and 2 in order to end up with the logo?

reflect along the x-axis

17. What is the equation of curve 3?

$$y = x^2 - 6x + 11 = \text{Curve 1}$$

$$= (x-3)^2 + 2$$

$$y = (x-3)^2 + 10$$

$$= x^2 - 6x + 9 + 10$$

$$= x^2 - 6x + 19$$

End of Assessment